SOFT REMOVABLE THERMAL SHIELD FOR A MISSILE SEEKER HEAD

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a thermal shield and, in particular, it concerns a soft removable thermal shield for a seeker head of a guided missile.

By way of introduction, some guided missiles have an internal seeker head which is disposed behind a window, which is located at the nose of the missile. Typically, the seeker head and often the window itself are sensitive to heat exposure, which is caused by friction of the missile body with air during supersonic or hypersonic flight. This heat exposure can result in breakage to the window and damage to the seeker head. Additionally, the seeker head is typically not used for the entire flight, but only during the terminal phase of the flight. Therefore, the window of the missile should be covered by a thermal protector during the first phases of the flight while the seeker head is not used.

One prior art thermal protector is a rigid thermal protector which covers the window during the first phases of the flight and which is retracted from the window during the terminal phase of the flight. A shortcoming of this thermal cover is its cost and mechanical complexity.

Another prior art thermal protector is a rigid thermal protector which covers the window during the first phases of the flight and which is released completely from the missile at the beginning of the terminal phase of the flight. This thermal cover is less costly and mechanically simpler than the first prior art thermal cover. A shortcoming of this thermal cover is that when this thermal

cover is released it may hit the rear part of the missile, thereby causing damage to the missile.

There is therefore a need for an inexpensive thermal shield for a missile seeker that does not damage the missile when released.

SUMMARY OF THE INVENTION

The present invention is a soft removable thermal shield for a guided missile seeker head and a method of operation thereof.

According to the teachings of the present invention there is provided, a soft removable thermal shield for protecting a heat-sensitive element of a projectile, comprising: (a) a main body configured to: (i) cover at least part of a window of the projectile, the element being disposed behind the window; (ii) thermally protect the element during at least part of a flight of the projectile; and (iii) be sufficiently soft upon being released from the projectile during the flight that the main body is substantially harmless to the projectile after being released; and (b) an attachment arrangement for releasably connecting the main body to the projectile.

According to a further feature of the present invention the main body includes an ablative material.

According to a further feature of the present invention the ablative material is ablative rubber.

According to a further feature of the present invention, there is also provided: (c) a reinforcement of the main body.

According to a further feature of the present invention the reinforcement includes at least one layer of textile fabric.

According to a further feature of the present invention, there is also provided: (c) a protective layer that is disposed adjacent to the window when the main body is operationally connected to the projectile, wherein a coefficient of friction between the protective layer and the window is sufficiently low to allow the main body to release substantially easily from the window and to leave the window substantially clean of a residue of the main body.

According to a further feature of the present invention the protective layer includes at least one layer of glass fiber fabric.

According to a further feature of the present invention the attachment arrangement includes at least one cord, the at least one cord having two ends, one of the ends being configured for attachment to the main body, and another of the ends being configured for attachment to the projectile.

According to a further feature of the present invention the attachment arrangement includes at least one cord, the at least one cord having two ends and a middle section, at least part of the middle section being mechanically connected to the main body, each of the two ends being configured for attachment to the projectile.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic view from above of a missile having a soft removable thermal shield disposed thereon that is constructed and operable in accordance with a preferred embodiment of the invention;

Fig. 2 is a cross-sectional view taken along line 2-2 of Fig. 1;

Fig. 3 is a detailed cross-sectional view of a main body and an attachment arrangement of the thermal shield of Fig. 1; and

Fig. 4 is a detailed cross-sectional view of a main body and an alternate attachment arrangement of the thermal shield of Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a soft removable thermal shield construction and method of operation thereof.

The principles and operation of the soft removable thermal shield according to the present invention may be better understood with reference to the drawings and the accompanying description.

Reference is now made to Fig. 1 and Fig. 2. Fig. 1 is a schematic view from above of a horizontally flying projectile **10**, specifically a guided missile, having a soft removable thermal shield **12**, disposed on the nose section **18** thereof, that is constructed and operable in accordance with a preferred embodiment of the present invention. Fig. 2 is a cross-sectional view taken

along line 2-2 of Fig. 1. Thermal shield **12** has a main body **14** and an attachment arrangement **16**. Nose section **18** includes a window **20**. Within projectile **10** and behind window **20** is an element **22**, for example a seeker head, which is sensitive to thermal exposure. Main body **14** is configured to cover window **20** and to thermally protect element **22** and window **20** during the initial part of the flight of projectile **10**. Main body **14** is also configured to be sufficiently soft, upon release from projectile **10** during the flight, that main body **14** is substantially harmless to projectile **10** after being released. The softness of main body **14** takes into account the relative velocities of main body **14** and projectile **10** after the release of main body **14** from projectile **10**. In particular, main body **14** is substantially harmless to the tail section **24** of projectile **10**. In accordance with a preferred embodiment of the present invention, main body **14** is inherently soft. In accordance with a most preferred embodiment of the present invention main body **14** is initially relatively rigid but becomes soft during the flight, for example, by being formed from an ablative material such as ablative rubber whereby main body **14** is thick and hard at the beginning of the flight, but enough of main body **14** ablates during the flight so that main body **14** is soft when released. It should be noted that an ablative material, such as ablative rubber, provides thermal protection to element **22** and window **20**, as the ablative material absorbs heat by ablating. Attachment arrangement **16** is configured to operationally connect main body **14** and projectile **10** prior to the release.

Reference is now made to Fig. 3, which is a detailed cross-sectional view of main body **14** and projectile **10** of thermal shield **12** of Fig. 1. Main body **14** typically includes an outer layer **26** of reinforced ablative material, typically ablative rubber, which is reinforced by one or more layers **28** of textile fabric. Outer layer **26** faces away from window **20** when main body **14** is operationally connected to projectile **10**. Therefore, outer layer **26** and reinforcement layers **28** provide a flexible, soft thermal protection. In accordance with a preferred embodiment of the present invention, thermal shield **12** also includes at least one protective layer **30**, typically formed from glass fiber fabric. Protective layer **30** forms an inner layer of main body **14**, such that, protective layer **30** is disposed adjacent to window **20** when main body **14** is operationally connected to projectile **10**. The coefficient of friction between protective layer **30** and window **20** is sufficiently low to allow main body **14** of thermal shield **12** to release substantially easily from window **20** and to leave window **20** substantially clean from a residue of main body **14**. Attachment arrangement **16** includes at least one cord **32**. In accordance with a most preferred embodiment of the present invention, cord **32** has two ends **34**, **36** and a middle section **38**. Part of middle section **38** is mechanically connected to main body **14**, typically by sandwiching middle section **38** between layers **28** and protective layer **30**. End **34** and end **36** are configured for attachment to projectile **10**. Methods of attaching attachment arrangement **16** to projectile **10** and releasing therefrom are known to those skilled in the art.

Reference is now made to Fig. 4, which is a detailed cross-sectional view of main body **14** and an alternate attachment arrangement **16** of thermal shield **12** of Fig. 1. In accordance with an alternate preferred embodiment of the present invention, attachment arrangement **16** has at least two cords **40**, **42**. Cord **40** has two ends **44**, **46**. Cord **42** has two ends **48**, **50**. Ends **44**, **48** are mechanically connected to main body **14**, typically by sandwiching ends **44**, **48** between layers **28** and protective layer **30**. End **46** and end **50** are configured for attachment to projectile **10**.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather, the scope of the present invention includes both combinations and sub-combinations of the various features described hereinabove, as well as variations and modifications thereof that are not in the prior art which would occur to persons skilled in the art upon reading the foregoing description.